Project # CS-1114A-99
University of Florida

Jennifer Jacobs → watershed hydrology

Suresh Rao (Purdue Univ.) → vadose zone hydrology

Wendy Graham → groundwater hydrology, data analysis

Debbie Miller → vegetation ecology

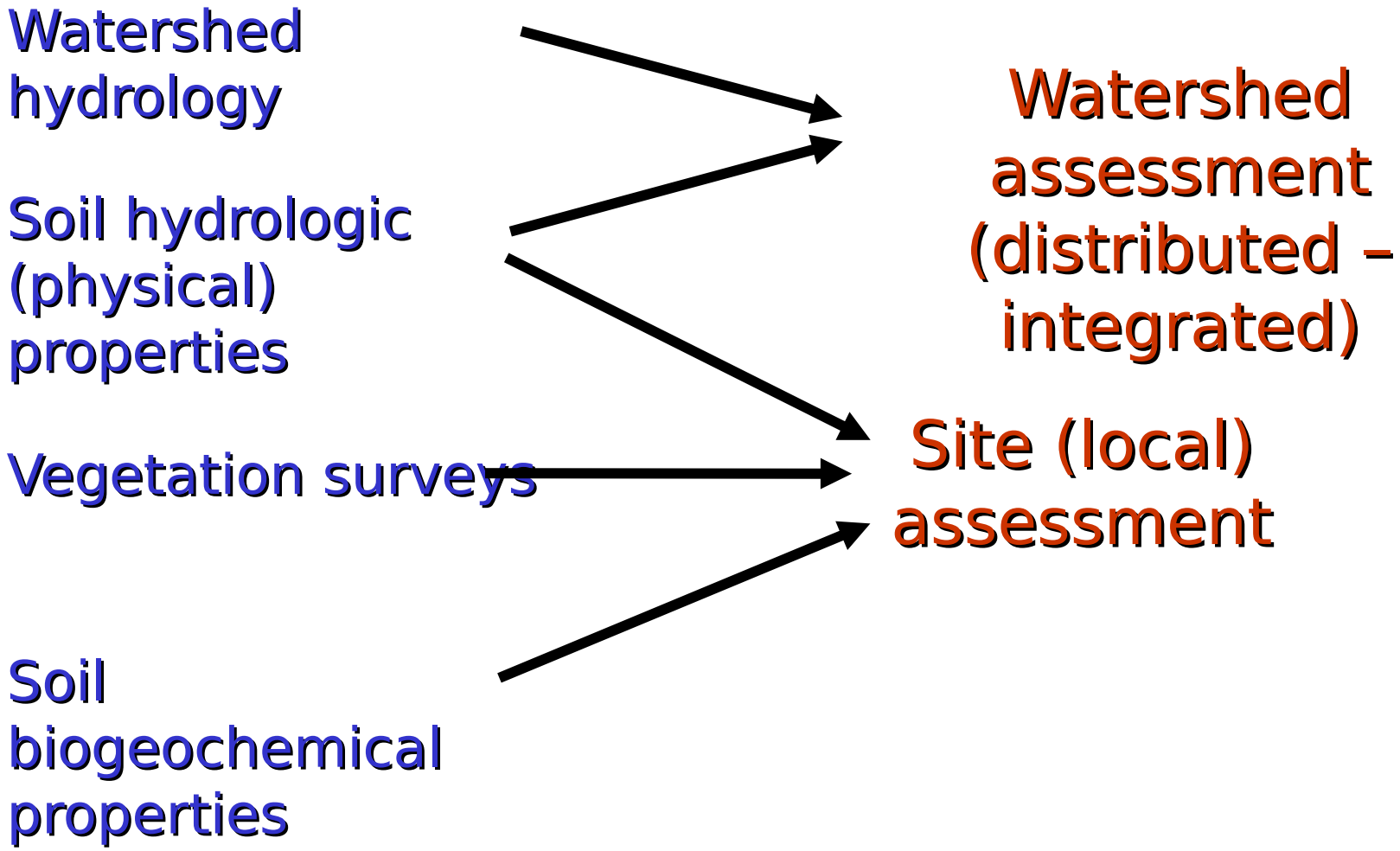
George Tanner → vegetation ecology

Bill DeBusk (PI) → soil biogeochemistry

Ramesh Reddy → soil biogeochemistry

Joe Prenger → soil microbial ecology, enzymes

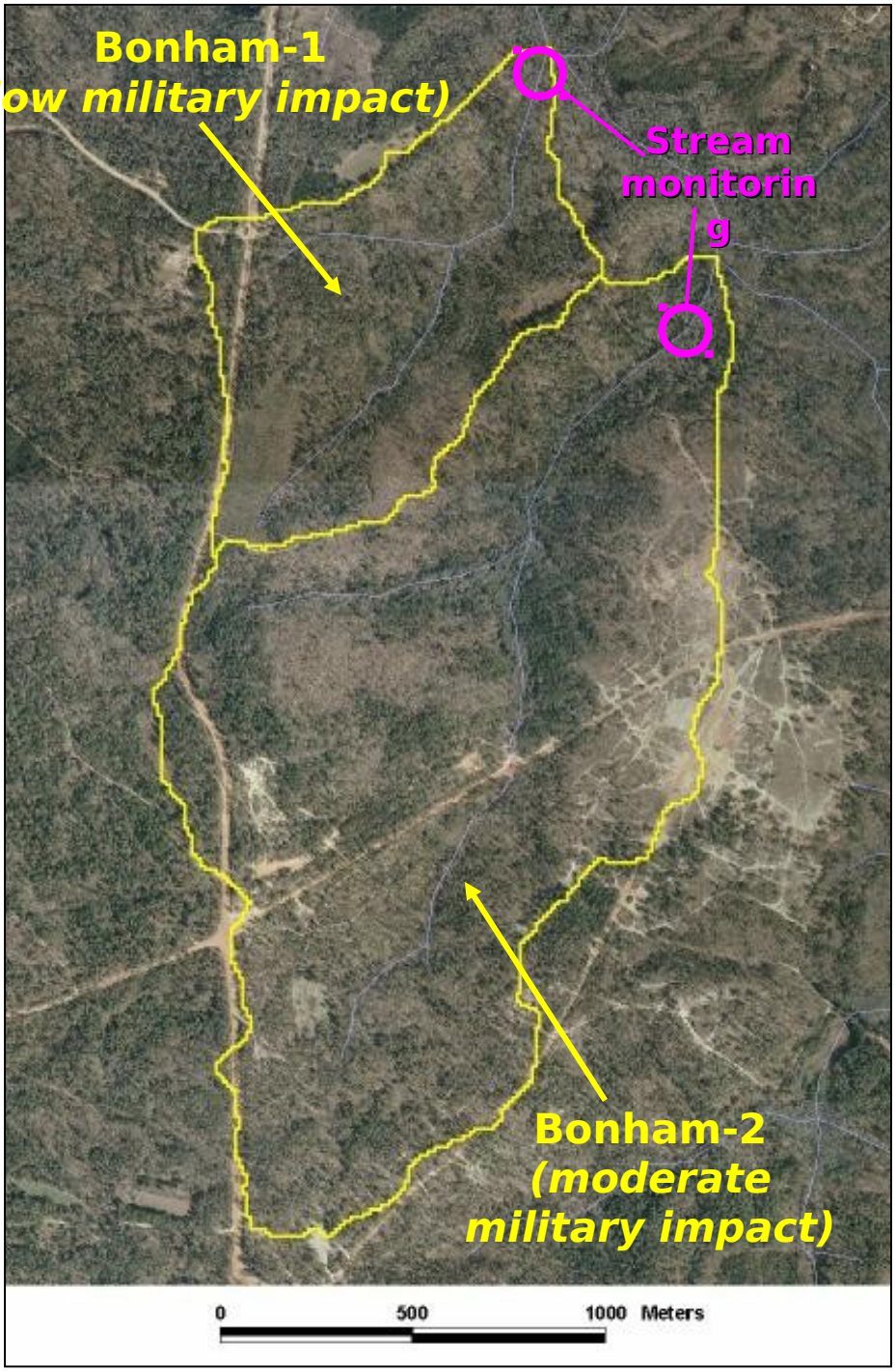
RESEARCH APPROACH

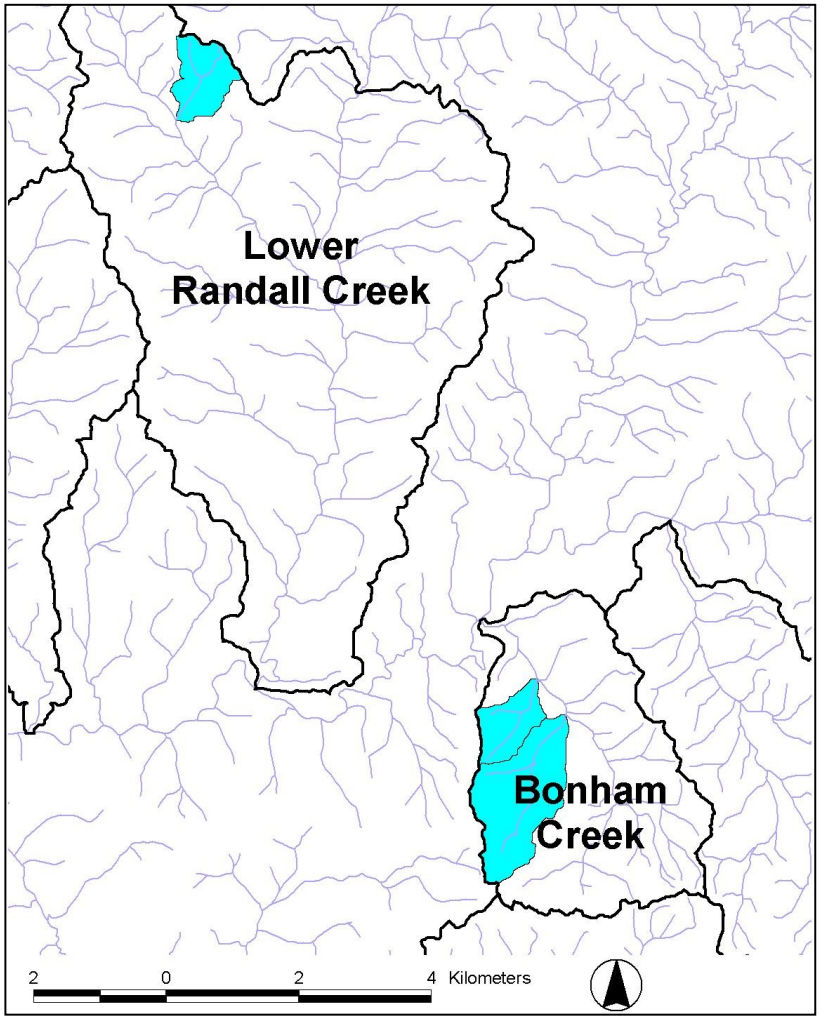


WATERSHED HYDROLOGY
(Jacobs)

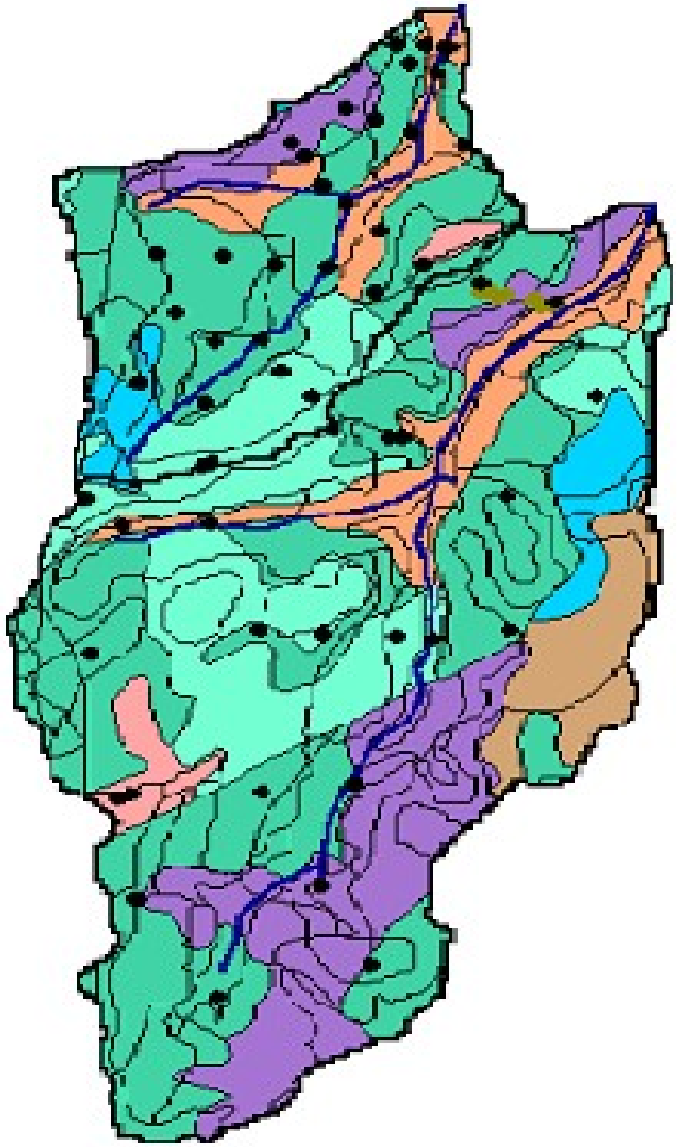
- Stream monitoring (watershed output)
  - Stage / discharge
  - Water quality (Hydrolab and stream chemistry)
  - Nutrient export
- Canopy throughfall (watershed input)
  - Water and nutrient influx
- Watershed modeling (TOPMODEL)
  - Inflows, outflows, water and nutrient budget
  - Relate to land use / disturbance

WATERSHED HYDROLOGY





CANOPY THROUGHFALL COLLECTION



Measures precipitation available for infiltration and runoff

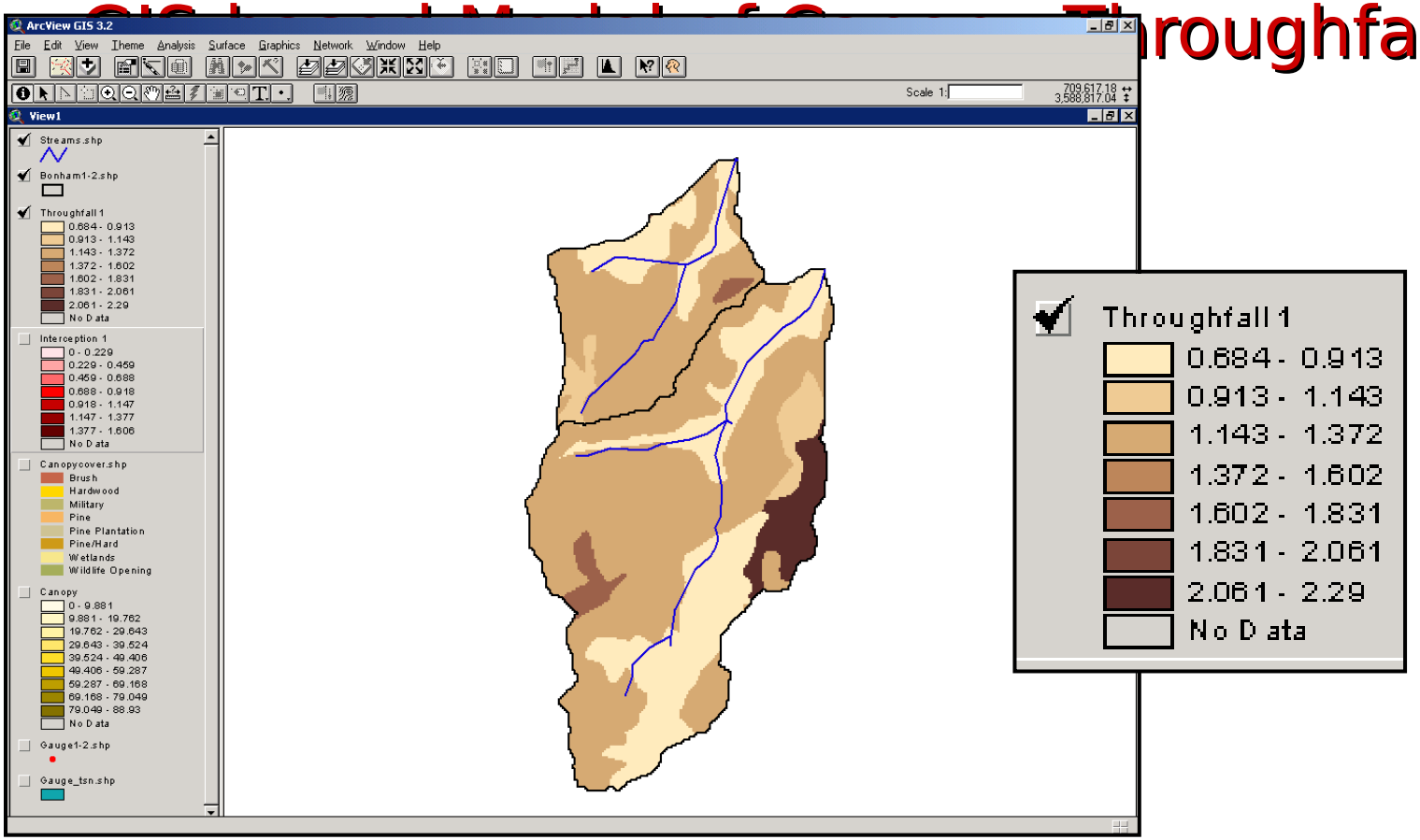
SPATIAL CHARACTERIZATION OF WATER INPUT

GIS-based Model of Canopy Throughfall

- Model will provide continuous estimates of water input across the installation based on rainfall and land cover
- Regional model application will differentiate among regions with the same cover using % canopy cover
- Potential applications/relationships:
  - soil chemical characteristics
  - water quality and quantity response
  - erosion potential
  - microbial activity / community structure

SPATIAL CHARACTERIZATION OF WATER INPUT

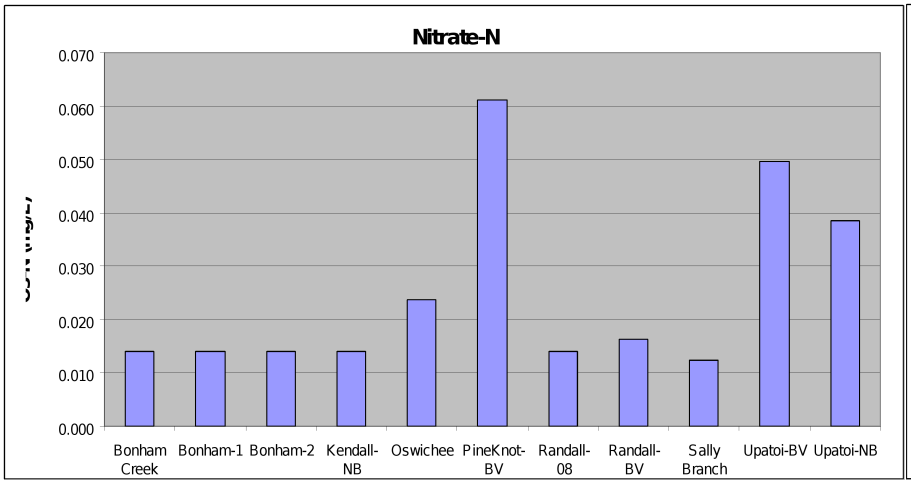
GIS-based Model of Canopy Throughfall

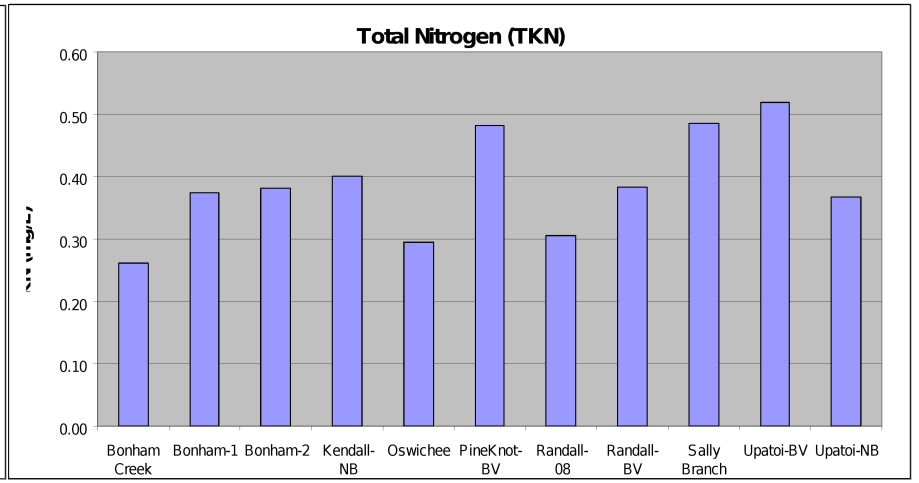


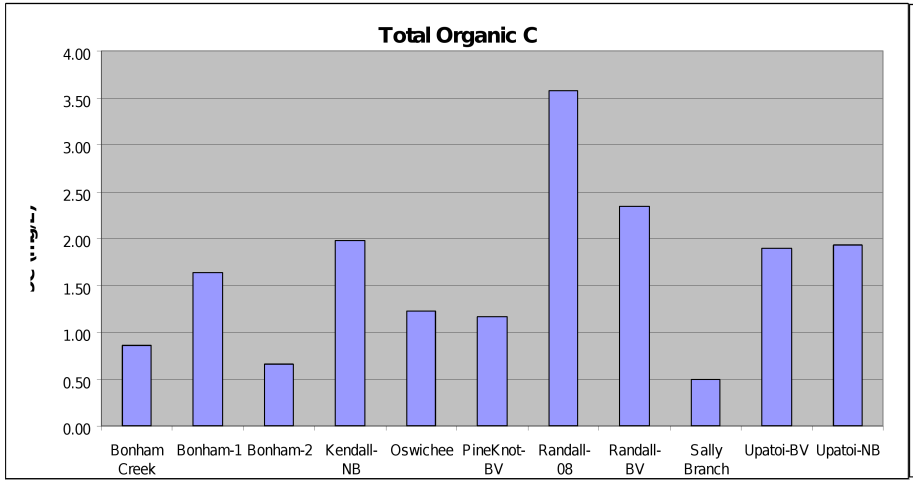
-- Influence of land cover on water input for single rainfall e

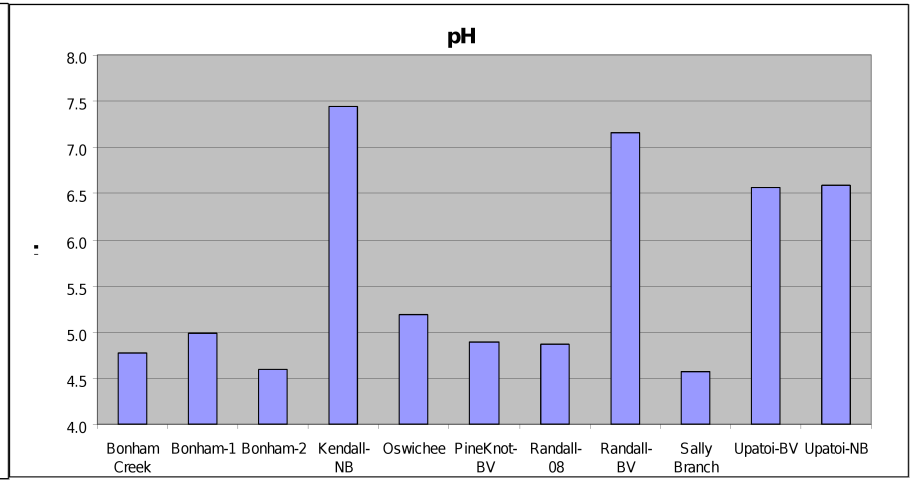
STREAM CHEMISTRY MONITORING

- Monthly / bi-weekly grab samples
- Selective event monitoring (autosampler)









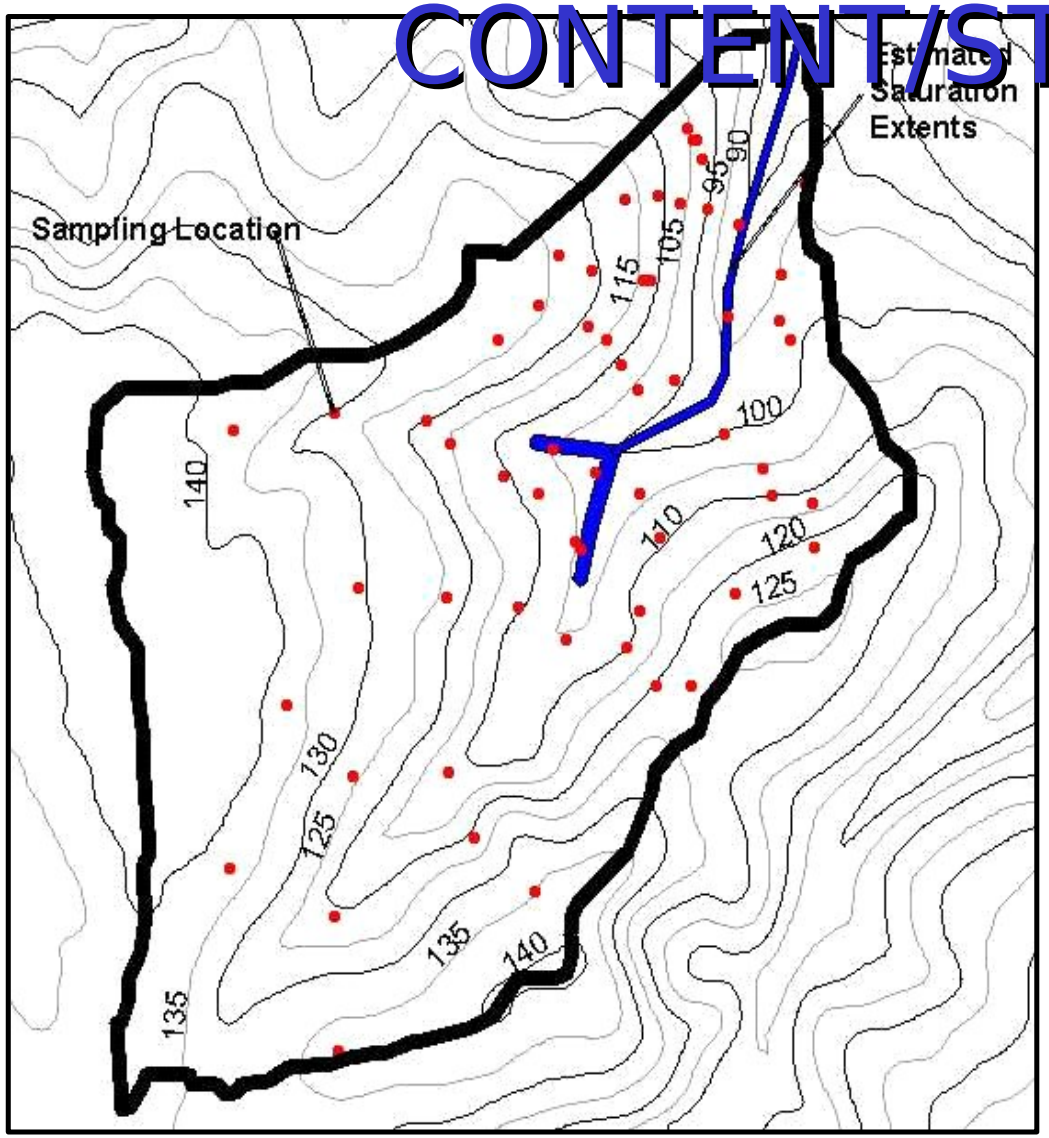
WATERSHED HYDROLOGY

(Rao, Purdue Univ.)

Soil Water Content/Storage

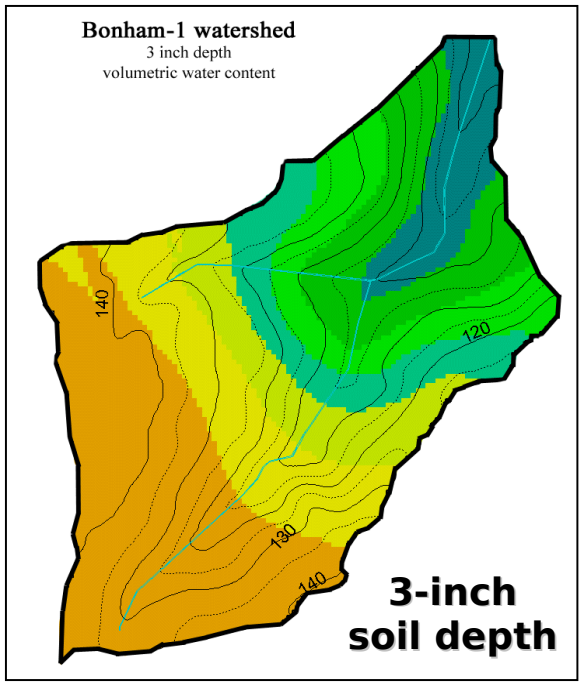
- Spatial/temporal changes in soil water storage
- Comparison of high-low disturbance watersheds
- Estimate total water storage and spatial moments of water content within the catchment using an unbiased (e.g. kriging) geostatistical model
- Soil moisture data compared to stream gauge data to relate distributed storage dynamics to in-stream response

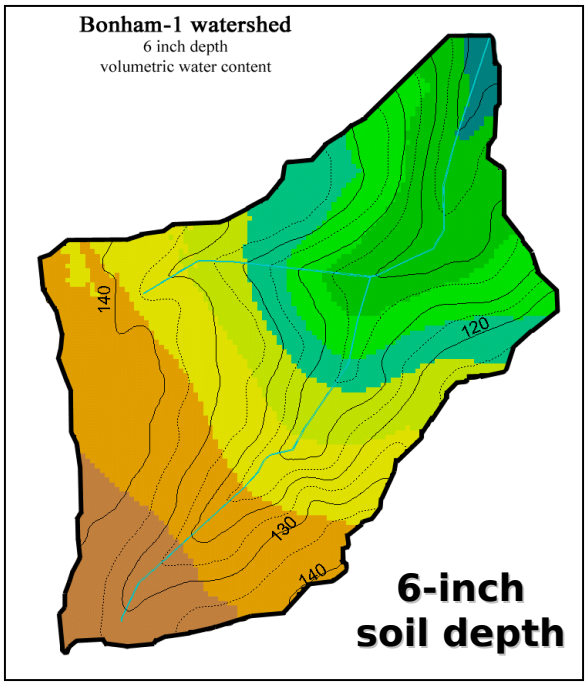
SOIL WATER CONTENT/STORAGE

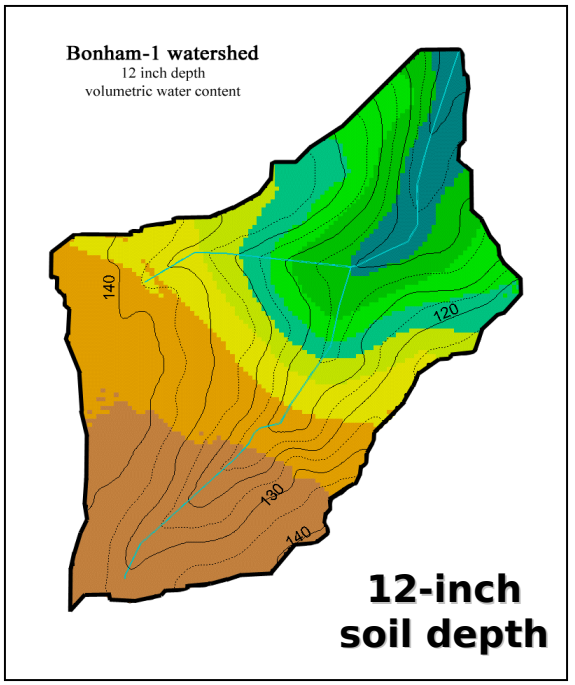


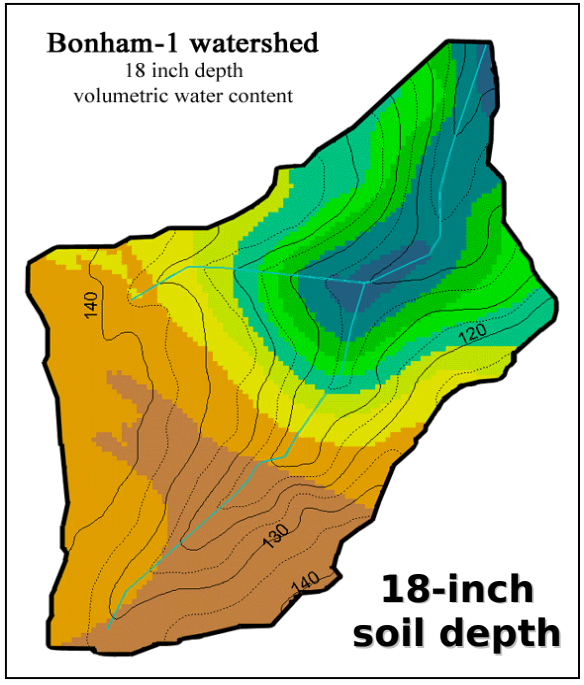
70 sampling locations in 0.25 catchment (Bonham-1 watershed)

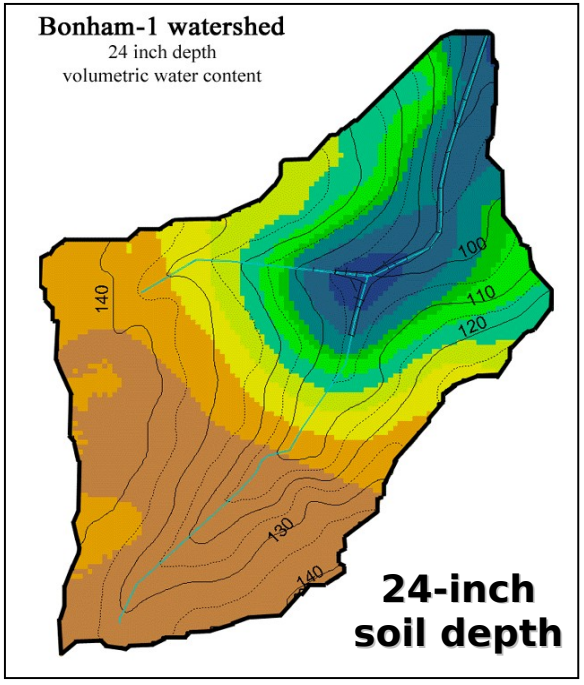
TH2O water content prob





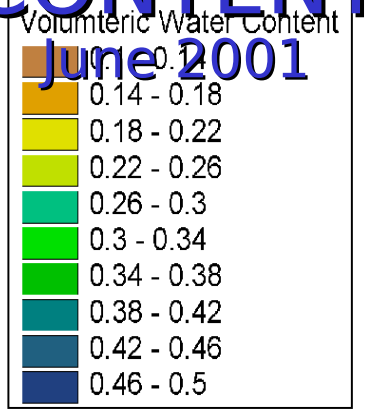






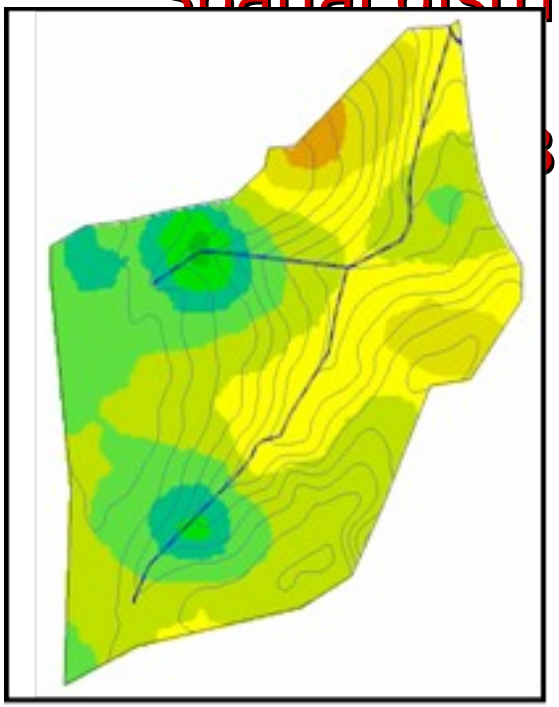
SOIL WATER CONTENT

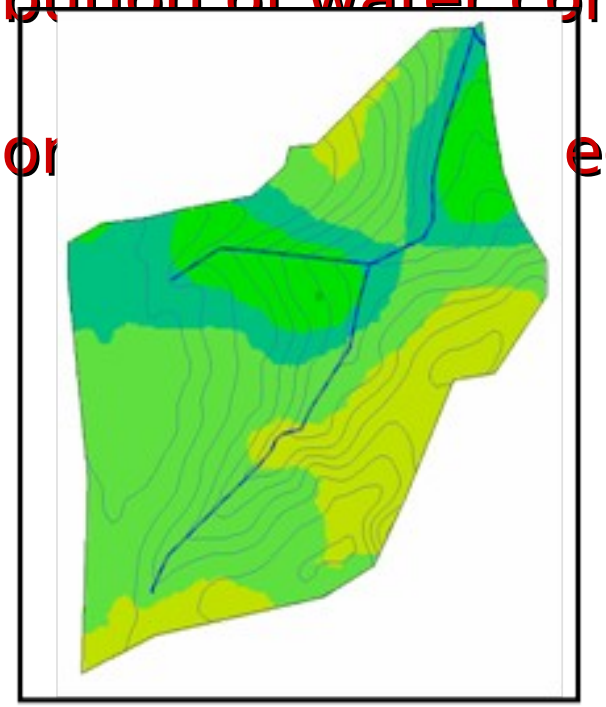
June 2001

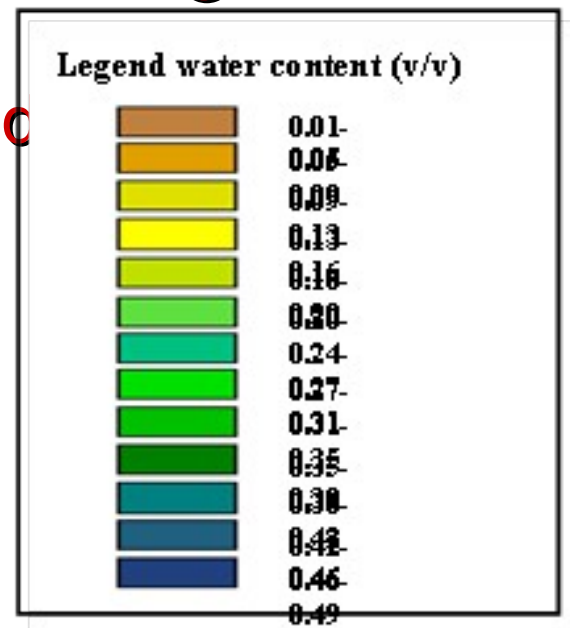


SOIL WATER CONTENT/STORAGE

Spatial distribution of water content @ 6-in.







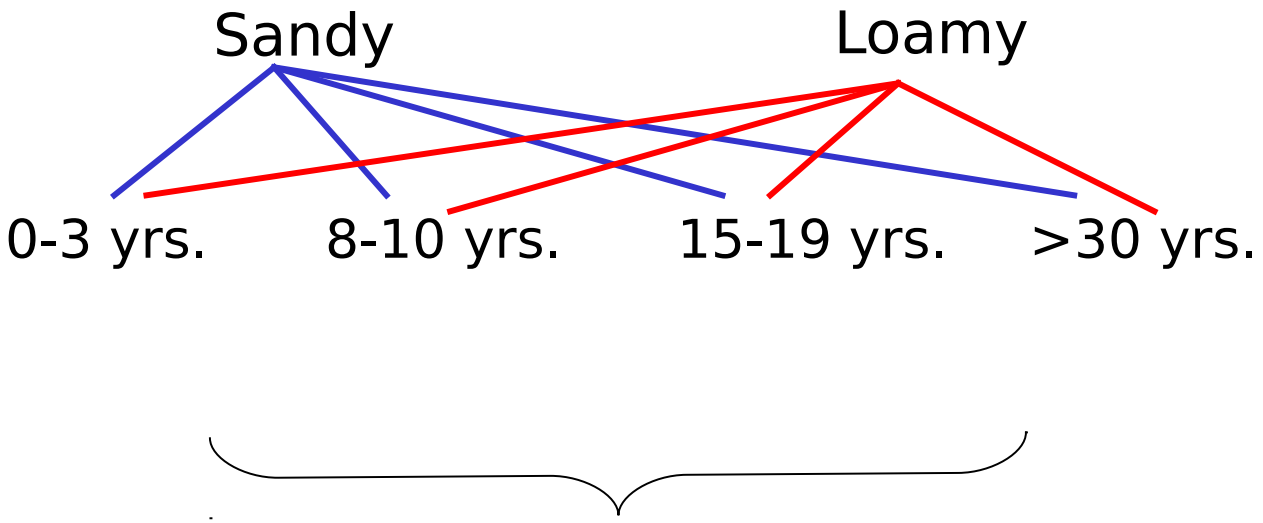
Pre-rainfall
(Jan. 18, 2002)

Post-rainfall
(Jan. 20, 2002)

VEGETATION ECOLOGY

(Miller and Tanner)

Silviculture Impacts on Sandy and Loamy Soils: Chronosequence Study (J. Archer)

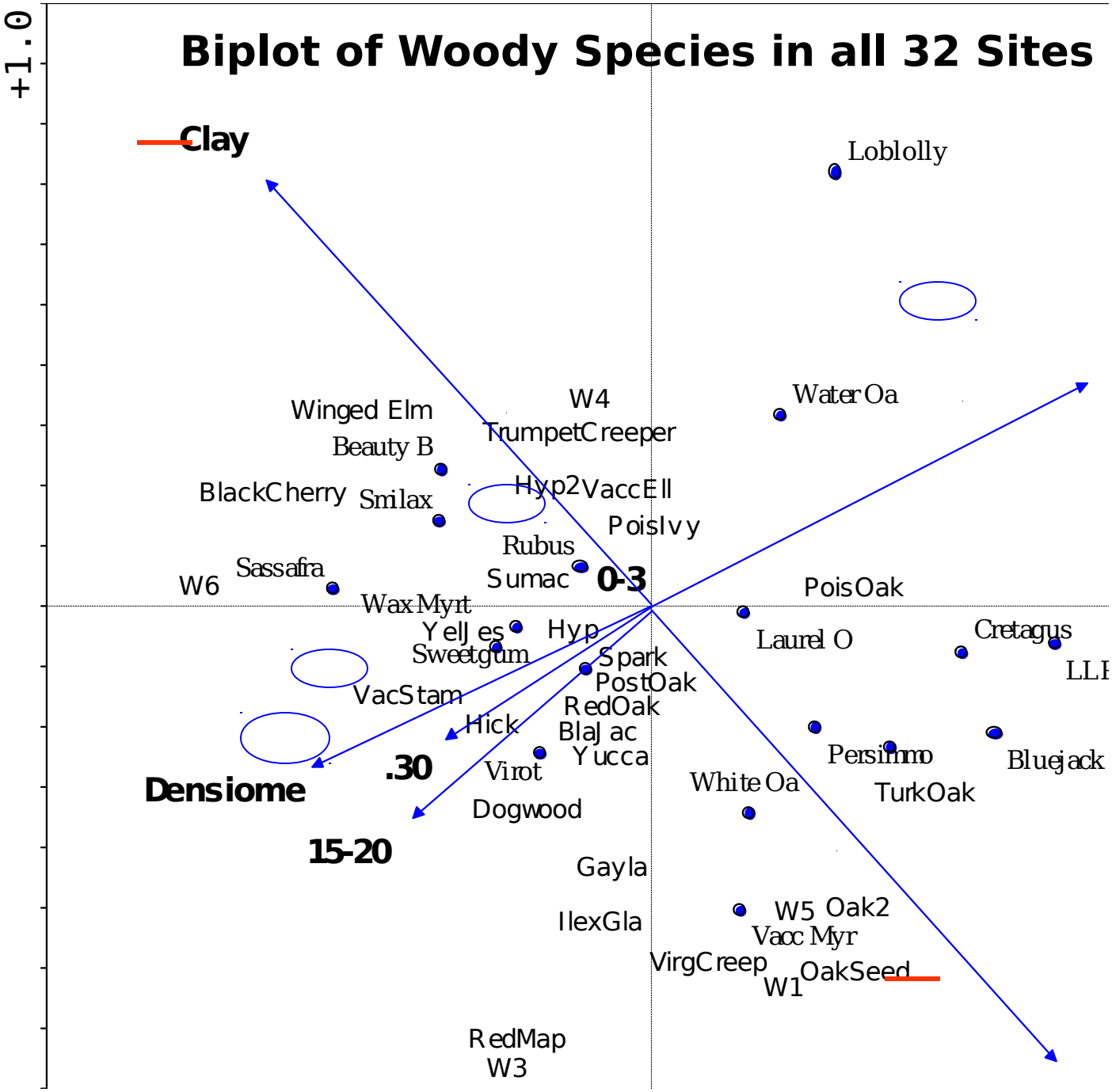


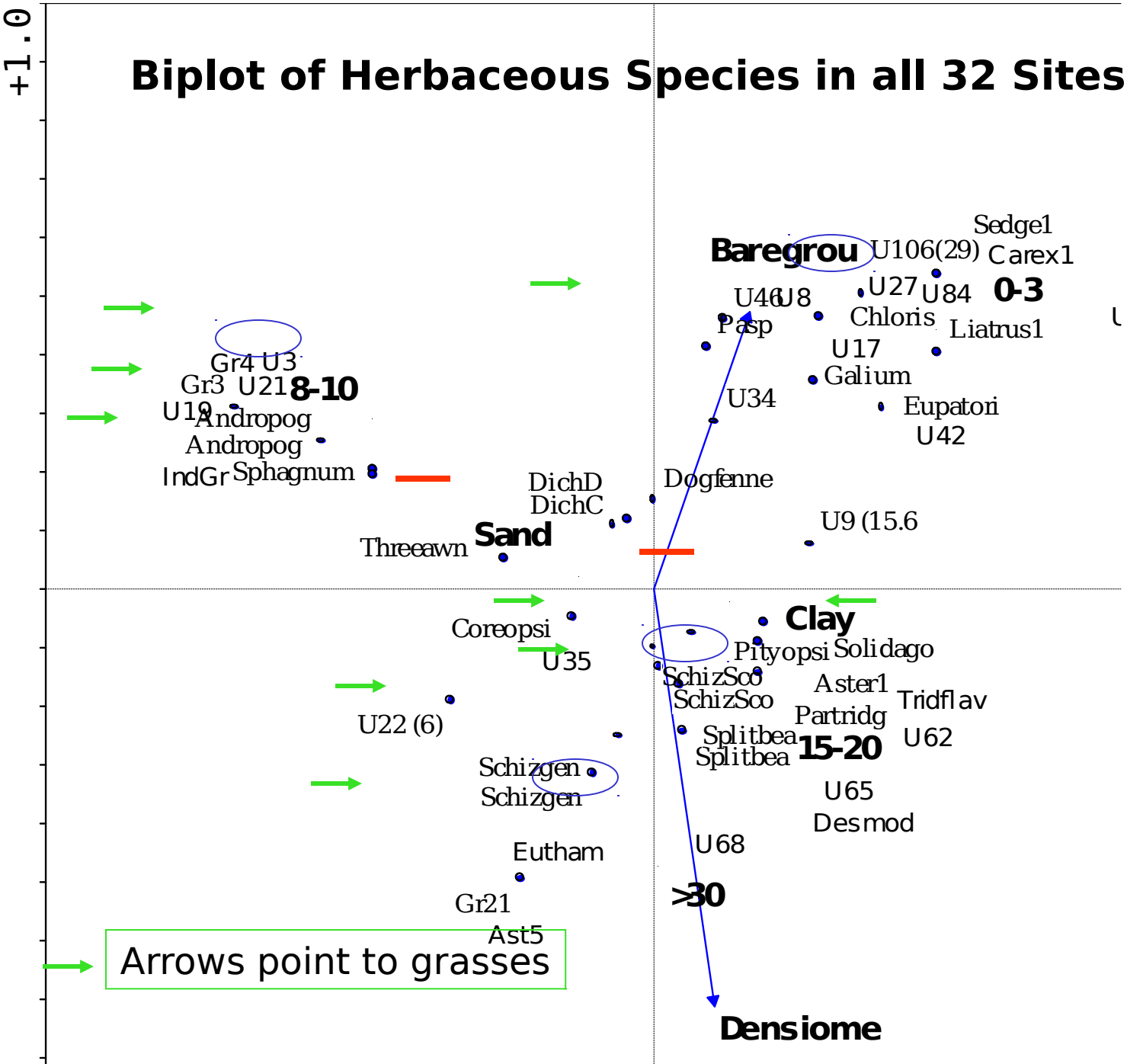
32 Sites: 4 sites in each age group in each soil type

EGETATION CHRONOSEQUENCE STUD

Initial Results

- As hypothesized, woody species show less distinct groupings
- Herbaceous species seem to be better indicators of disturbance levels
- Disturbance levels (time since last clear-cut) show 3 distinct groups of herbaceous species
- Soil type (sand vs. clay) does not group the species as well as disturbance level
- Grasses seem to be the best indicator of disturbance level
- No apparent distinction between the two older classes (15-20 yrs. and >30 yrs.)


Biplot of Woody Species in all 32 Sites
+1.0
Clay
Loblolly
Winged Elm
W4
WaterOa
TrumpetCreeper
Beauty B
Hyp2VaccEll
BlackCherry
Smilax
PoisIvy
Rubus
Sassafra
W6
Sumac
0-3
PoisOak
WaxMyrt
YelJes
Hyp
Laurel O
Cretagus
Sweetgum
Spark
LLP
PostOak
VacStam
RedOak
Hick
BlaJac
Persimmo
Bluejack
Yucca
.30
Virot
WhiteOa
Densiome
TurkOak
Dogwood
15-20
Gayla
W5
Oak2
IlexGla
Vacc Myr
VirgCreep
OakSeed
W1
RedMap
W3


+1.0
Biplot of Herbaceous Species in all 32 Sites
Baregrou
Sedge1
U106(29)
Carex1
0-3
U46
U8
U27
U84
Pasp
Chloris
Liatrus1
U17
Galium
U34
Eupatori
U42
Gr4
U3
Gr3
U21
8-10
U19
Andropog
Andropog
IndGr
Sphagnum
DichD
DichC
Dogfenne
U9 (15.6
Threeawn
Sand
Coreopsi
Clay
Pityopsi
Solidago
U35
SchizSco
SchizSco
Aster1
Tridflav
Partridg
U22 (6)
Splitbea
Splitbea
15-20
U62
Schizgen
Schizgen
U65
Desmod
U68
Eutham
>30
Gr21
Ast5
Arrows point to grasses
Densiome

EGETATION CHRONOSEQUENCE STUD

Initial Results

Grasses – Potential Indicators

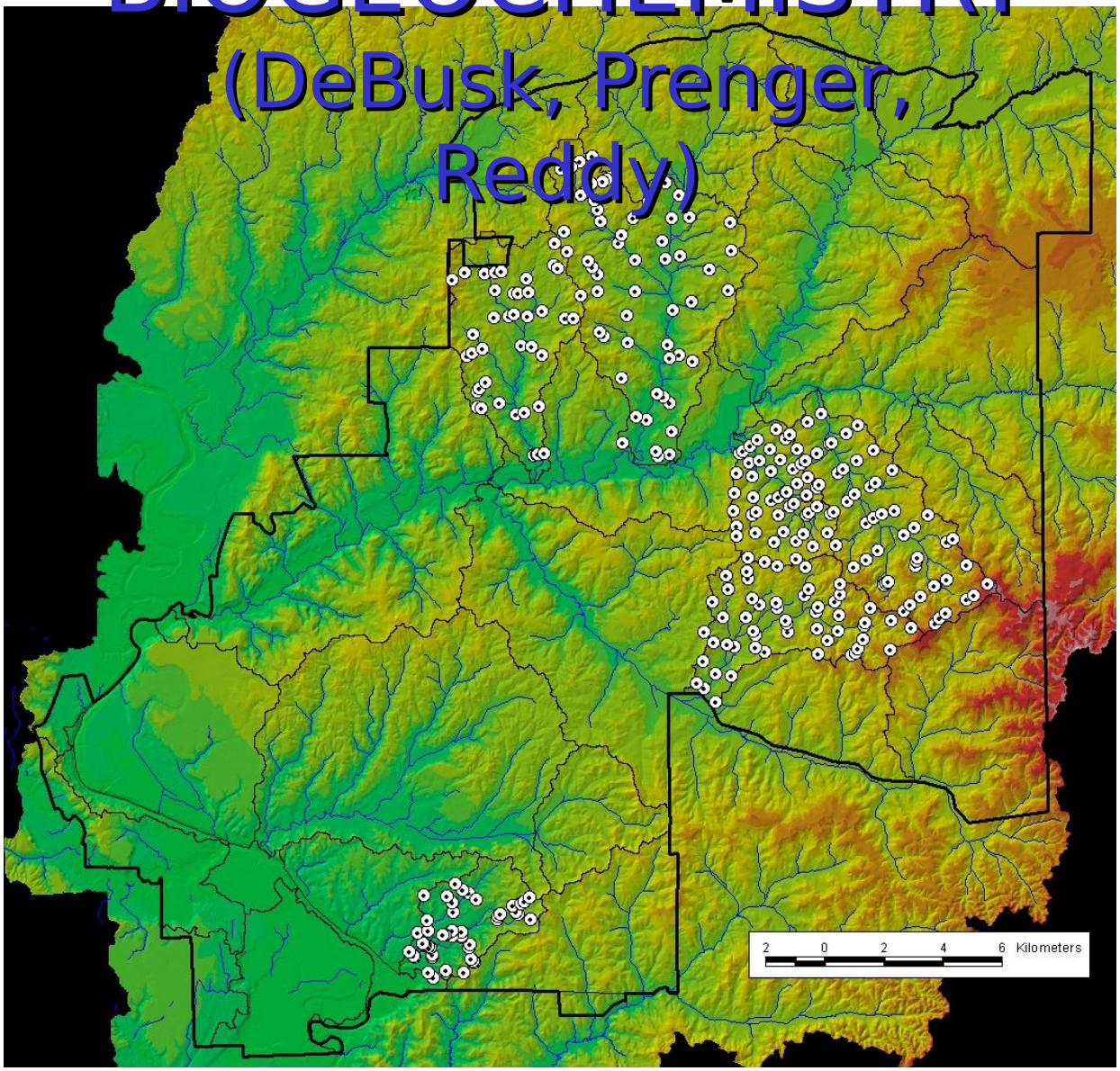
Schizachyrium scoparium	Little bluestem
Schizachyrium ternarius	Splitbeard
(or Andropogon ternarius)	
Andropogon virginicus	
Broomsedge	
Paspalum notatum	Bahia grass
Tridens flavus	
Purpletop	
Sorghastrum secundum	Lopsided Indiangrass

EGETATION CHRONOSEQUENCE STUD

Future Work and Considerations

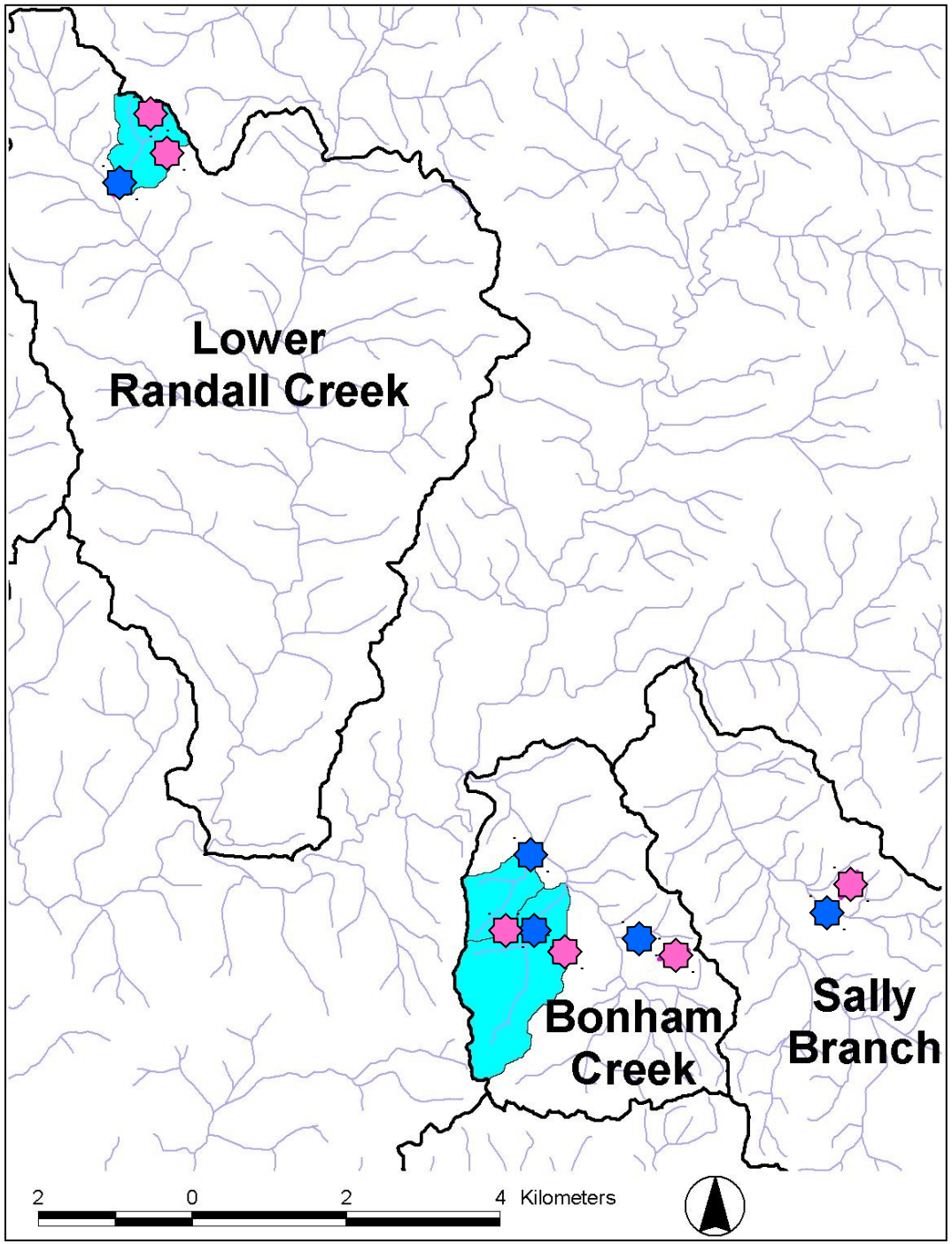
- Merge the vegetation data with the soils data
- Combined analyses – canonical correspondence analysis
- Analysis of data within each soil type – do the groupings become even more distinct?
- How do Phase I and Phase II results complement each other?

SOIL BIOGEOCHEMISTRY (DeBusk, Prenger, Reddy)



Soil Biogeochemistry (Phase 1):

pH
Total C Water Extractable C Microbial C Soil respiration (CO_2 prod.)
Total N Exchangeable NH_4^+ Microbial N PMN Arginine ammonification
Total P Water Extractable P HCl Extractable P Oxalate Extractable P Mehlich-1 P Microbial P
Mehlich-Fe, Al, Ca, Mg, K Oxalate-Fe, Al
Acid Phosphatase Beta-Glucosidase Dehydrogenase Protease Microbial diversity



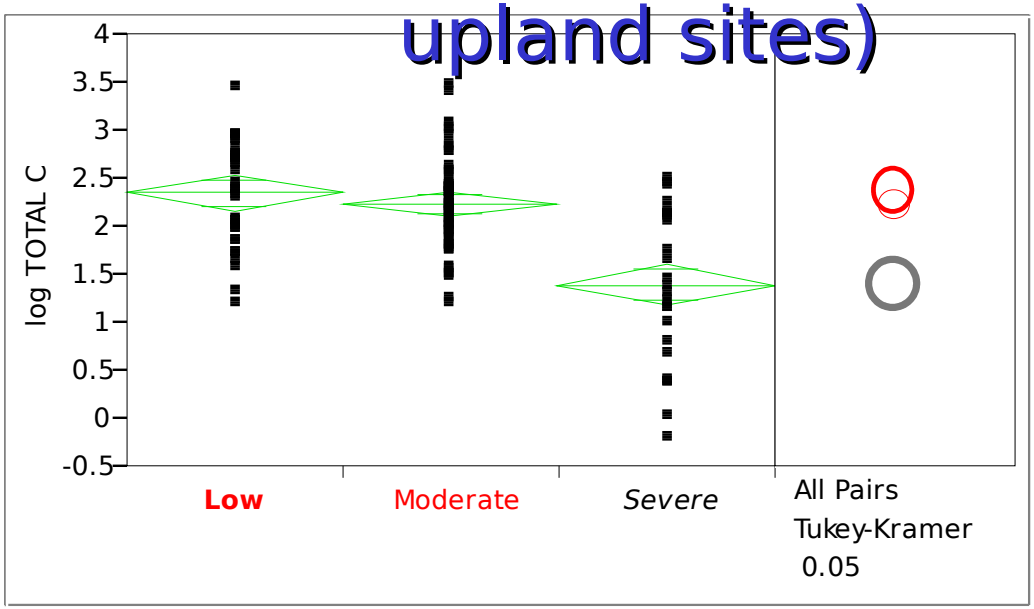
SOIL / VEGETATION TRANSECT SAMPLING (Phase 2)

- Upland area (200-400m length)
  - –Troup loamy sands
- Wetlands (80-100m length)
  - –Bibb soil series
- Sampled @ 20m (typical)

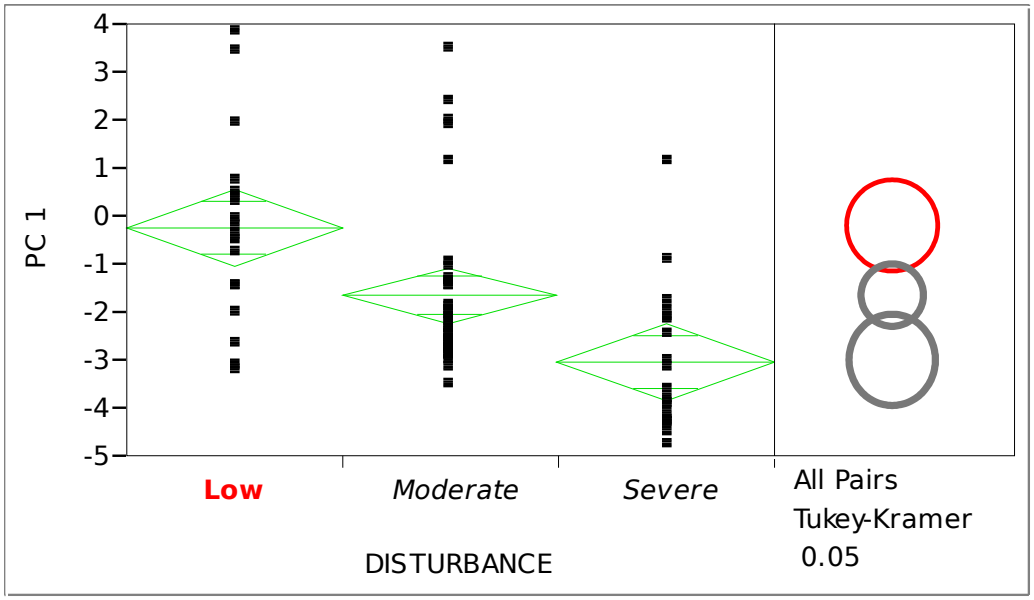
Characterize central tendencies and spatio-temporal variability:

- “homogeneous” sites
- gradients of military use
- land management gradients

SOIL BIOGEOCHEMISTRY (Phase 1 upland sites)



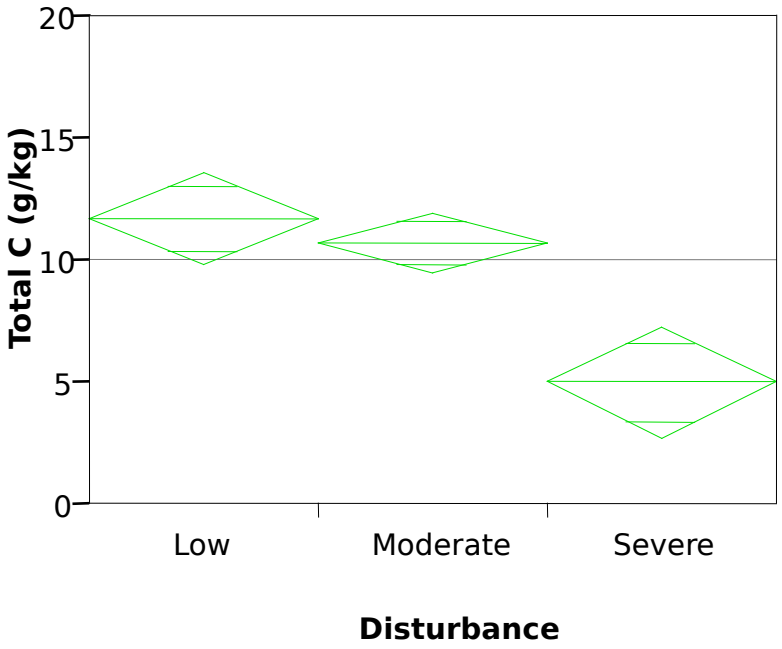
Total C (log)



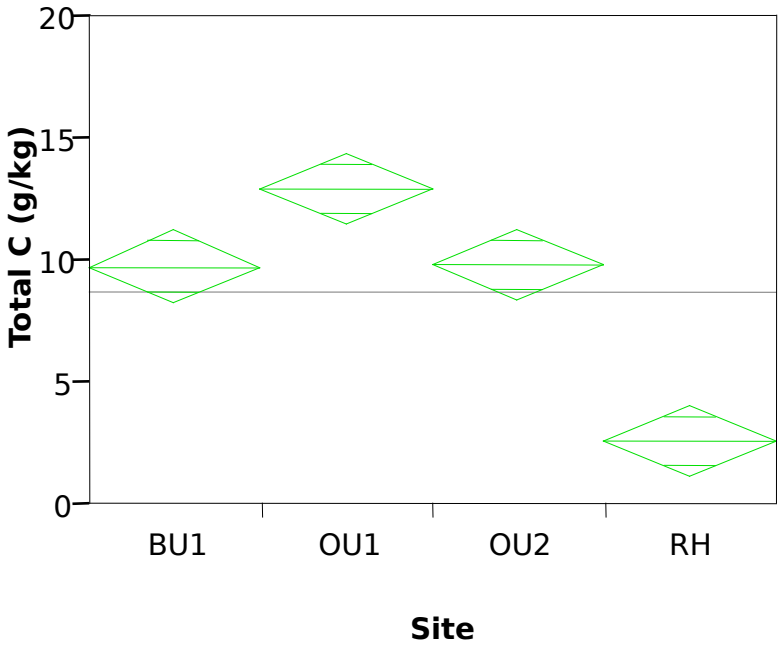
Prin. component 1

SOIL ORGANIC C STORAGE / TURNOVER

Phase 1
Multi-watershed sampling



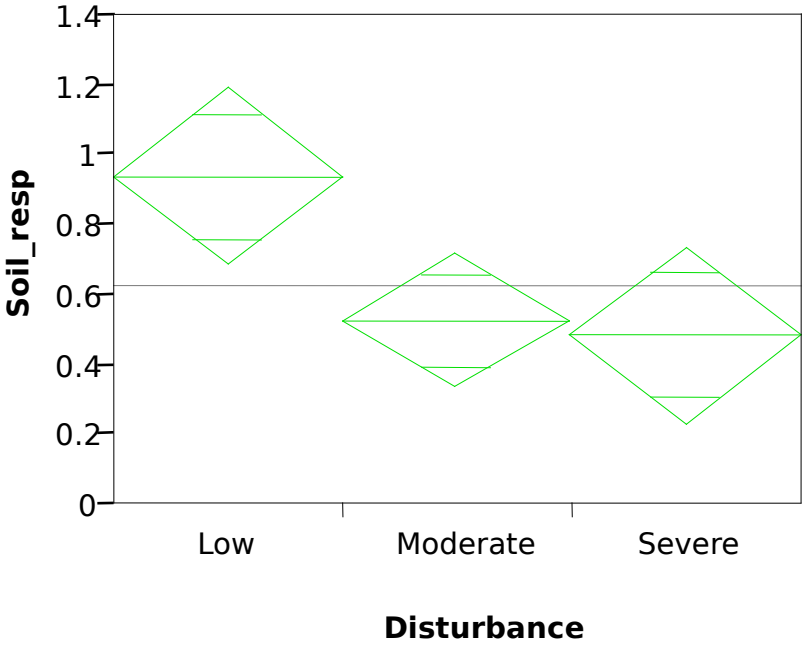
Phase 2
Transect sampling



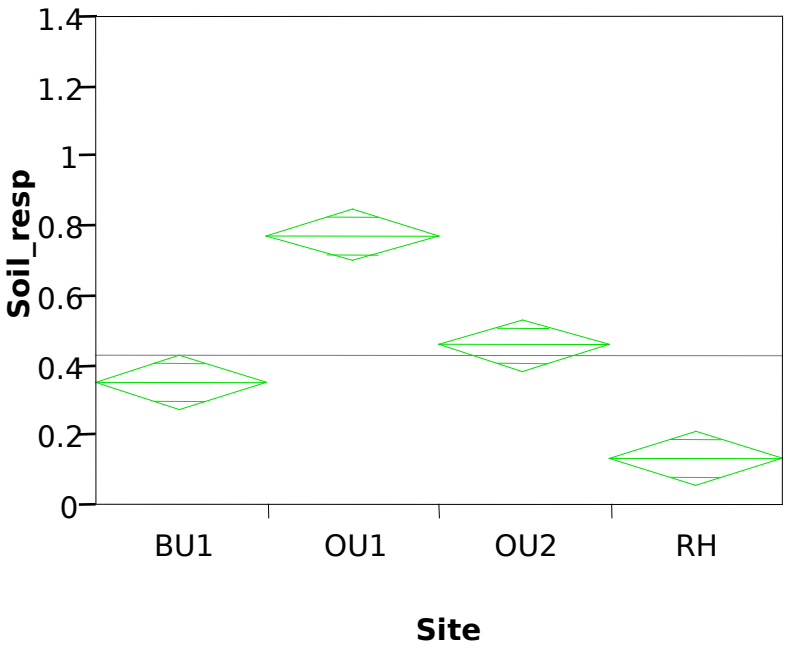
BU1 = “Low disturbance”
OU1 = Planted pines, 6 yrs.
OU2 = Planted pines, 12 yrs.
RH = Rowan Hill (tanks)

SOIL ORGANIC C STORAGE / TURNOVER

Phase 1
Multi-watershed sampling



Phase 2
Transect sampling



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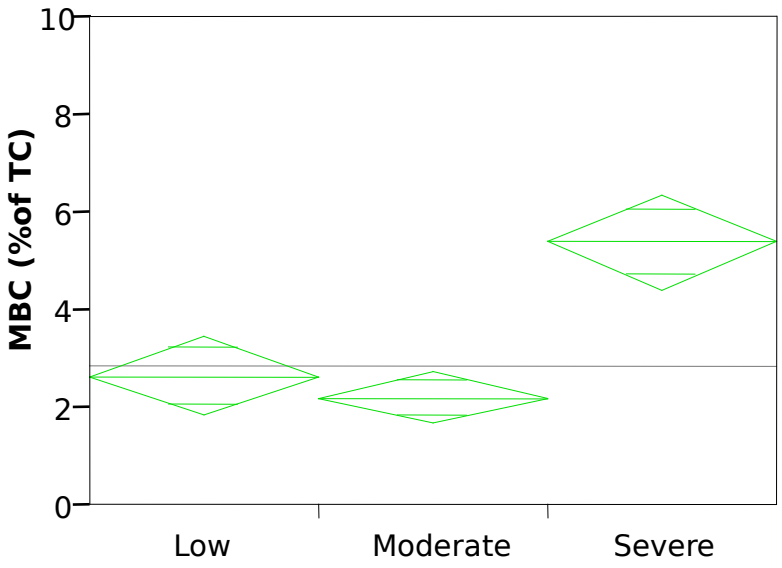

Phase 2
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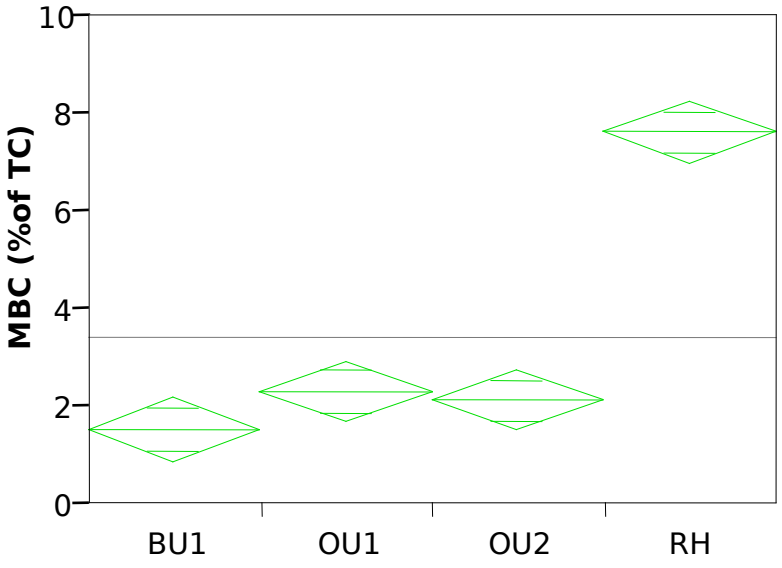

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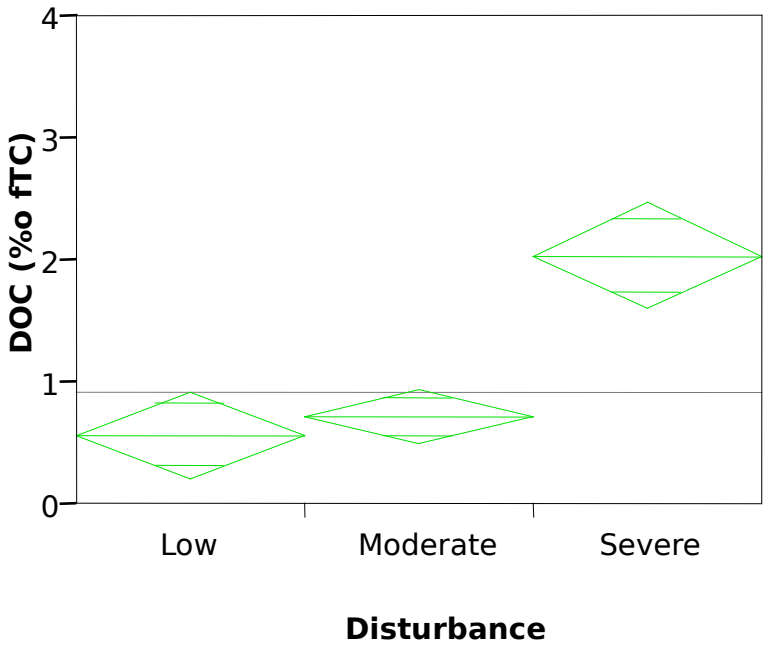
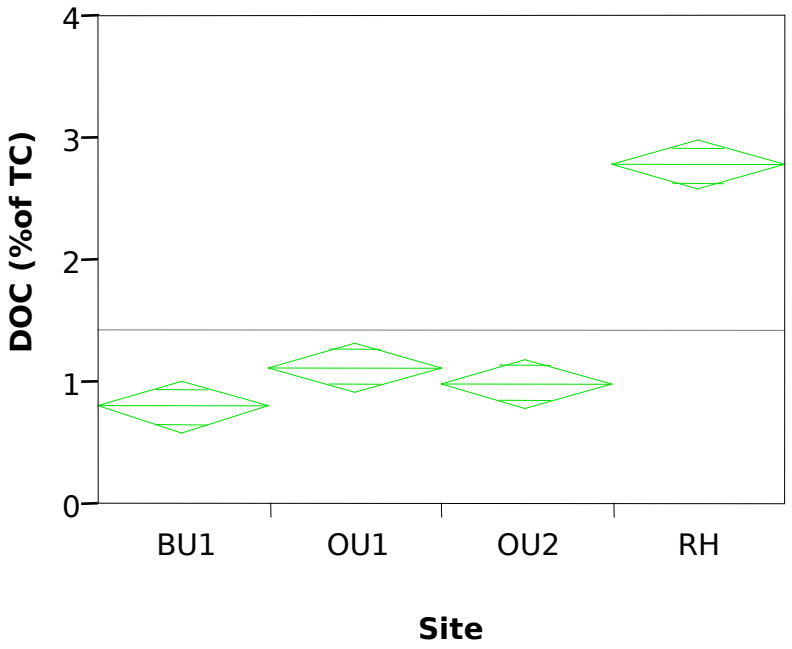


Phase 2
Transect sampling



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SOIL ORGANIC C STORAGE / TURNOVER

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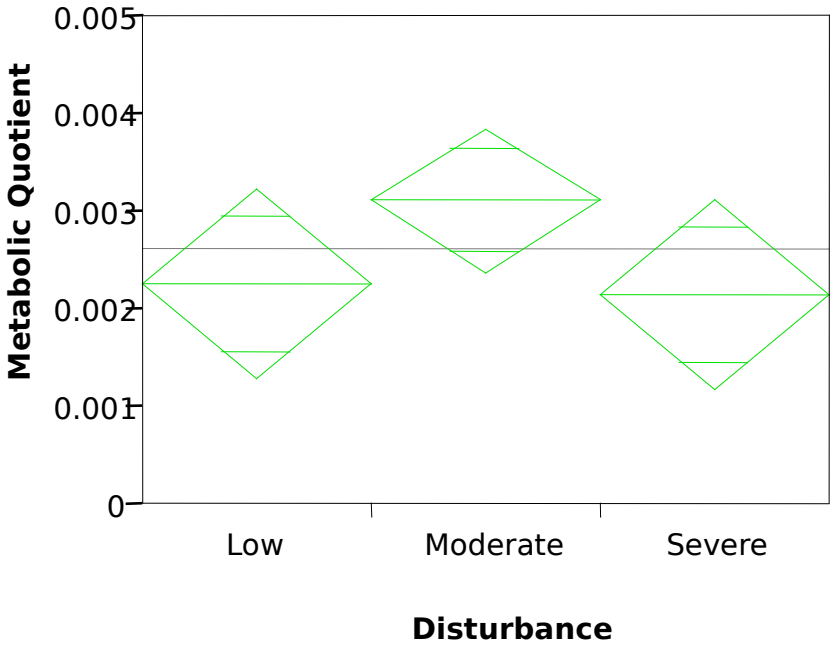
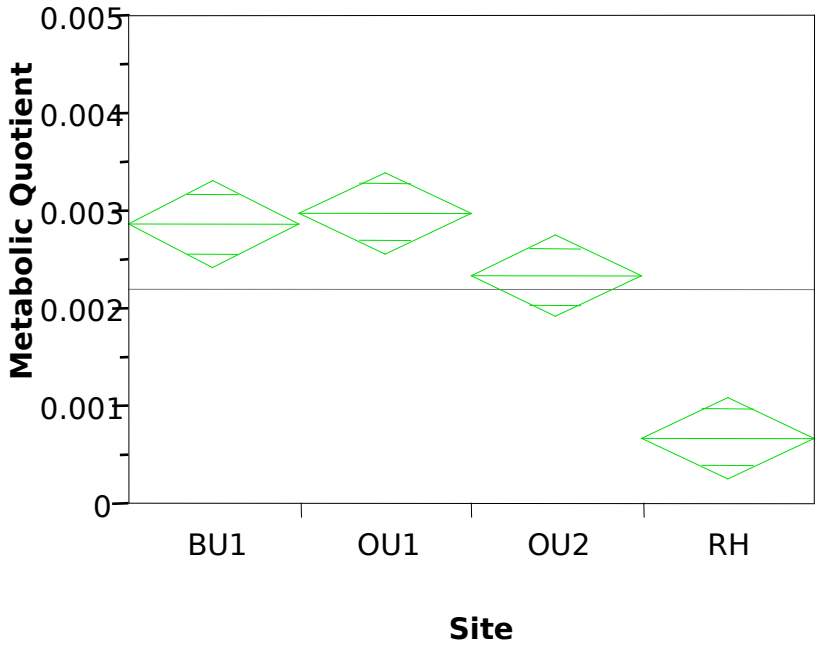
Multi-watershed sampling



Phase 2
Transect sampling



BU1 = “Low disturbance”
OU1 = Planted pines, 6 yrs.
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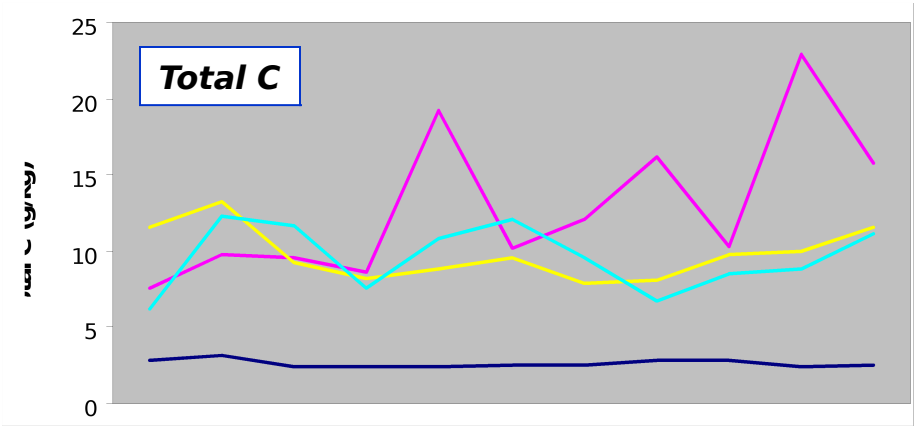
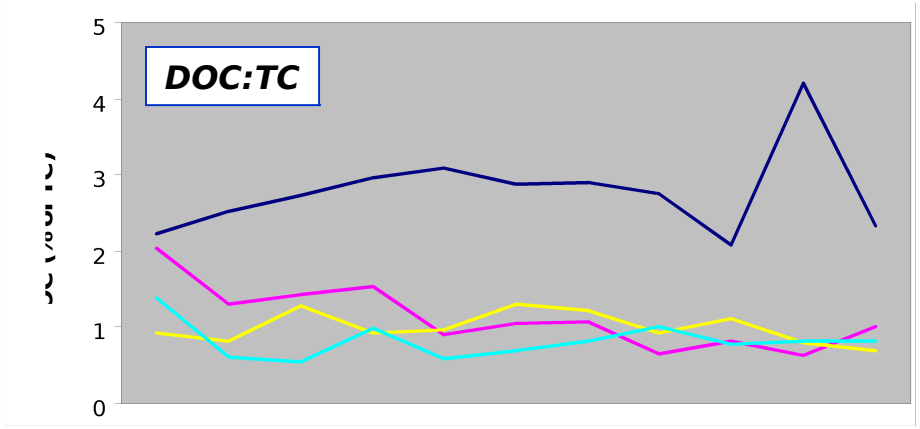
TRANSECT SAMPLING

Spatial/temporal variability





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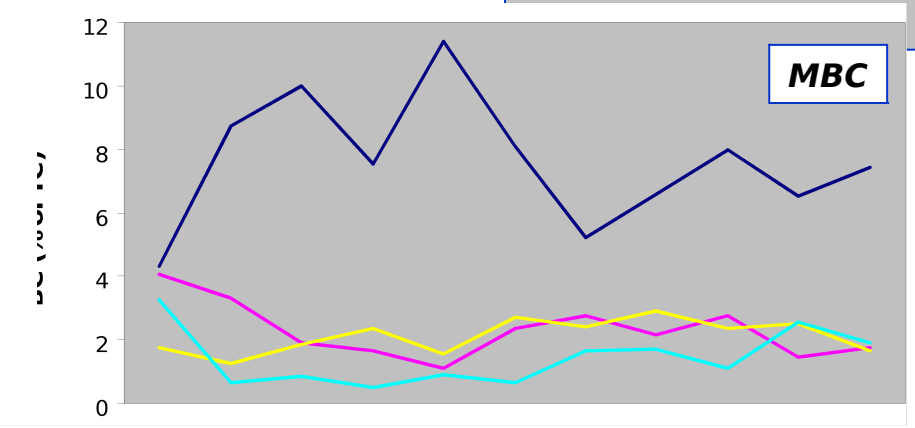
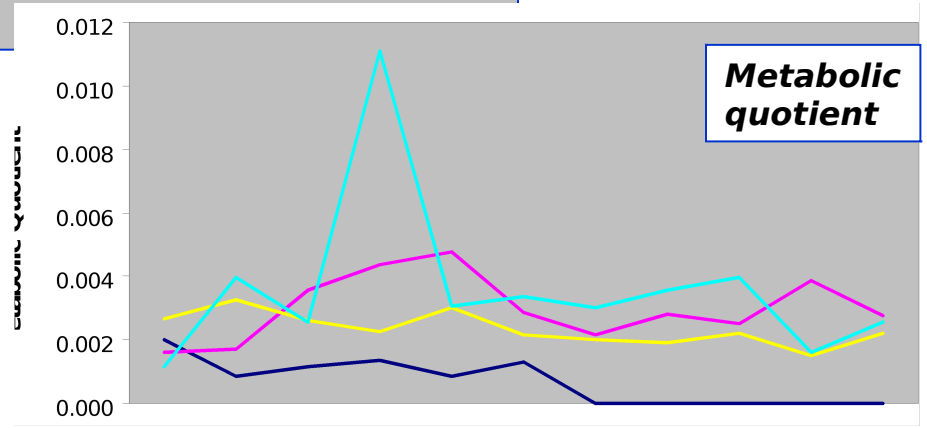
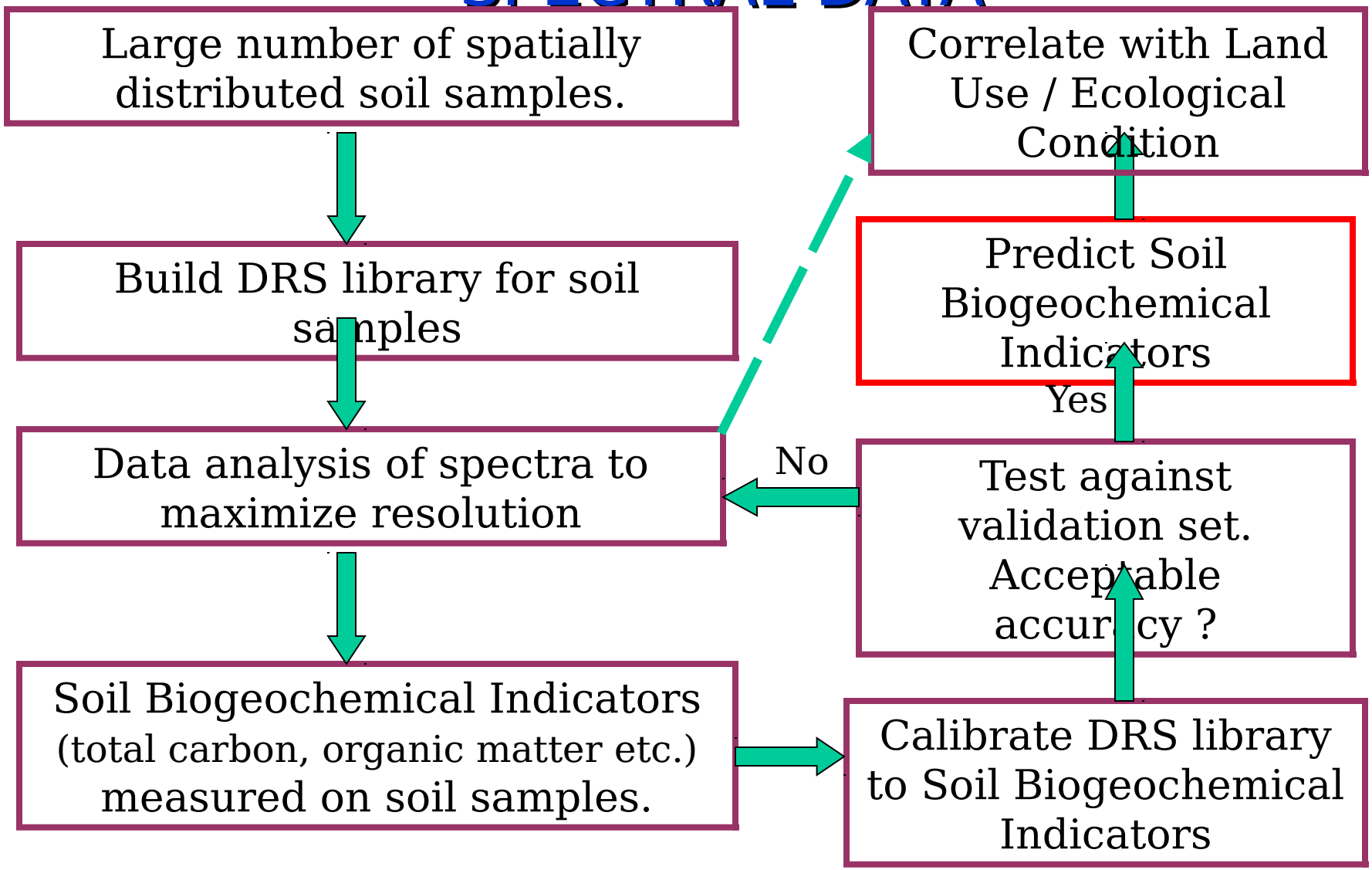




DIFFUSE REFLECTANCE SPECTROSCOPY (Prenger, Graham et al.)

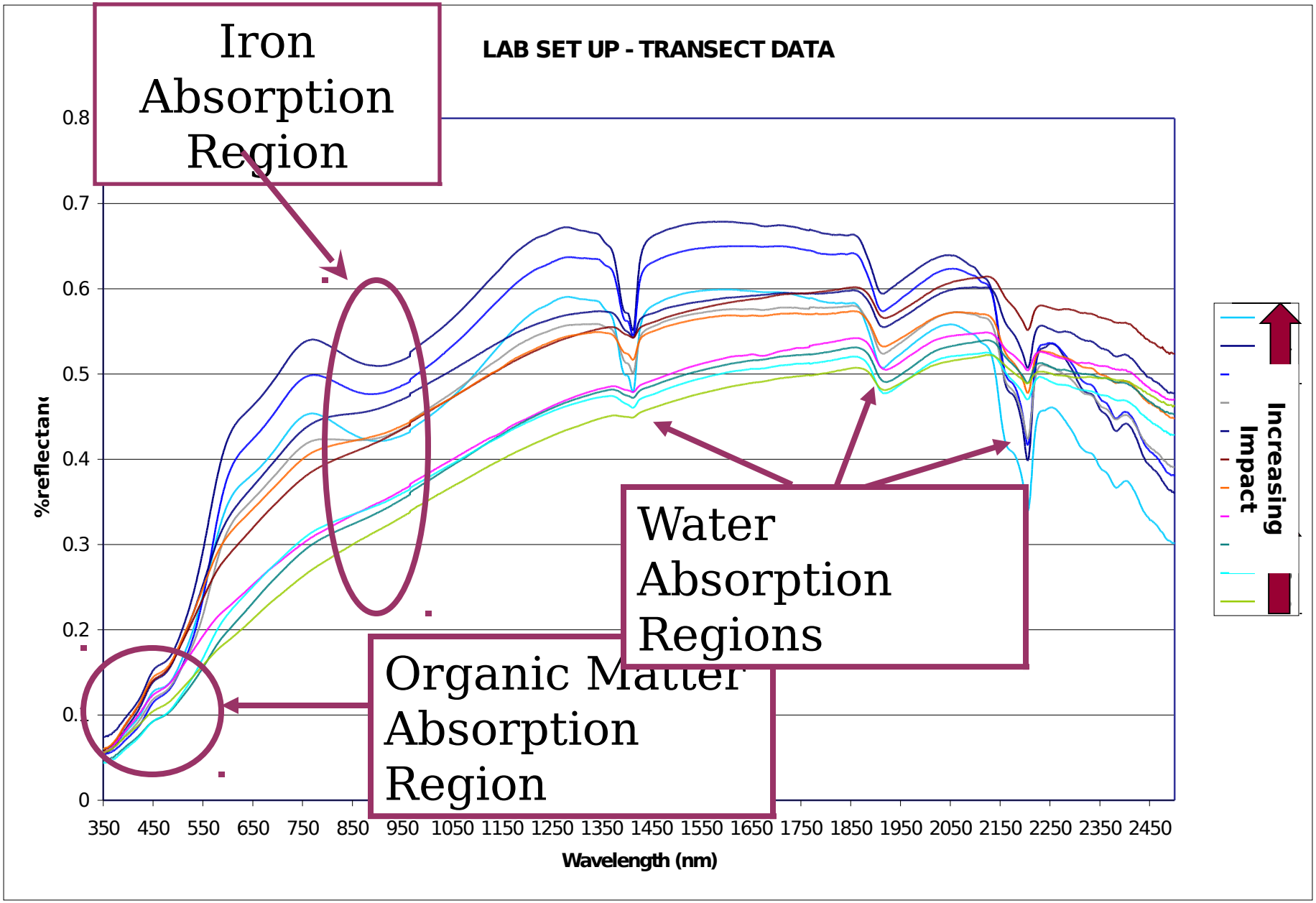
- Rapid, non-destructive estimation of soil properties
  - Laboratory measurement of excavated soils
  - Field measurements or remote sensing
- Reflectance Spectral Libraries (RSL) can be correlated to specific physical or chemical properties of soils
  - Organic Carbon
  - Exchangeable Ca, Mg, cation exchange capacity
  - Clay, Sand content
- 350 - 2500 nm spectral range (1 nm resolution) allows comparison with AVIRIS data

INDICATOR DEVELOPMENT USING SPECTRAL DATA


Large number of spatially distributed soil samples.
Build DRS library for soil samples
Data analysis of spectra to maximize resolution
Soil Biogeochemical Indicators (total carbon, organic matter etc.) measured on soil samples.
Calibrate DRS library to Soil Biogeochemical Indicators
Test against validation set. Acceptable accuracy ?
No
Yes
Predict Soil Biogeochemical Indicators
Correlate with Land Use / Ecological Condition

SPECTRAL DIFFERENTIATION OF SOILS

- Spectral Curves usually take either a concave or a convex shape between 500 to 1300 nm.
- Mineral soils show higher reflectance.
  - 1100 nm is iron absorption band (mineral soils).
  - Decrease in reflectance beyond 750 nm is common in iron dominated soils.
- Organic soils show less reflectance.
  - Change of slope around 600 nm has been related to organic matter (organic soils).
- 1400, 1900 and 2200 nm are water absorption bands.


Iron Absorption Region
LAB SET UP - TRANSECT DATA
Water Absorption Regions
Organic Matter Absorption Region
Increasing Impact
%reflectanc
Wavelength (nm)
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
350 450 550 650 750 850 950 1050 1150 1250 1350 1450 1550 1650 1750 1850 1950 2050 2150 2250 2350 2450

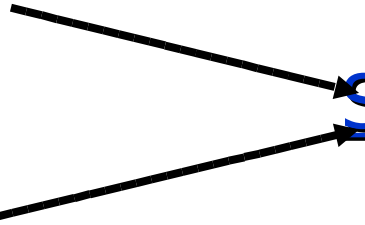
ANTICIPATED PRODUCTS

Throughfall/precip.
Soil water storage
Stream flow/chemistry
Watershed models

Watershed assessment

Vegetation cover, species

Soil physical, biological, chemical properties



Site assessment